**Building Fact Power with Fact Families:**

A Data Gathering/Problem Solving Unit for 1st Grade at John Muir Elementary School

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**Task 1.1- Curriculum and Topic**

***Curriculum:*** *Everyday Mathematics* ***Topic:*** Addition and Subtraction Fact Families

**Task 1.2- Rationale**

I chose the topic for this unit after discussing with my cooperating teacher where the class would be in the *Everyday Mathematics* curriculum during my teaching internship. Together, we decided that I should pull activities from Unit 6: Building Fact Power to create a smaller, more focused unit on fact families. *Everyday Mathematics* is a spiral curriculum structured around thematic units where various ideas and skills are introduced in a context such as learning about money or building number sense and revisited in future units. This allows for repeated exposure to topics over the course of the year in order to build on student knowledge as they progress through the curriculum rather than just covering a topic once and then not touching it again until the next grade level. However, the relatively brief and infrequent treatment of individual topics can make it difficult for students to understand concepts and familiarize themselves with skills before moving on to the next topic, which means that they will have trouble recalling and extending the concepts further in later units of the curriculum. For this reason, I have chosen to pull selected lesson topics on fact families from Unit 6 and add supplemental lessons so that students have a chance to focus on and fully master the concept of fact families and related skills.

In earlier units of *Everyday Mathematics: Grade 1*, students are introduced to simple addition and subtraction problems through the strategy of counting on or counting backwards as well as making 10. They have also become familiar with the use of manipulatives in solving problems. Addition and subtraction are essential building blocks for more complicated mathematical topics that students will learn towards the end of the year and in future grades. Fact families are particularly useful in that they show addition and subtraction number sentences in association with each other. By using the familiar context of a family, fact families encourage students to consider subtraction problems in terms of more familiar addition problems, thus increasing their comfort level with the oftentimes more difficult idea of subtraction. By taking the concept of addition and subtraction fact families from introduction to mastery, I hope to give students extensive practice in a strategy for solving addition and subtraction problems that deepens understanding of the relationship between addition and subtraction. This unit will give students additional practice with the basic addition and subtraction facts that they will need to be able to quickly access in order to conduct more complex computations and build on in order to comprehend more complicated concepts as well. I will also use simple word problems to relate the concepts that students are learning to real life.

When teaching this unit, I will need to remain aware of certain moral and ethnic considerations. Most importantly, I must keep in mind the importance of mathematics in everyday life. Reading and writing are important skills that people utilize on a daily basis, but the necessity of mathematics cannot be overlooked either. Almost all jobs require the use of mathematics to some extent, whether workers are making change, planning and budgeting business trips, or calculating projected stock returns. Problem solving and computational skills and number sense are also crucial outside of work as well. Among other things, fiscally responsible adults must be able to keep track of the money in their bank account through estimation, know how to calculate tips, and use basic algebra and fractions to figure out how to allocate their paychecks. Early elementary mathematics provides the base of deep understanding of basic concepts and skills that students will need to succeed in later grades of elementary school and beyond. As an educator in the early elementary grades, it is my responsibility to make sure that all students experience success and build confidence in basic math skills and number sense so that they continue to develop and use skills the field of mathematics as they mature. I must provide positive learning experiences that will allow all students to reach their potential in mathematics.

**Task 1.3- Description of Learning**

After this unit, students will understand the inverse relationship between addition and subtraction and know that familiarity with an addition fact can help solve a related subtraction problem. They will understand what addition and subtraction fact families are and how they can be used to think about and solve addition and subtraction problems. They will be able to create fact families if given a number sentence or two addends between 0 and 9 and also be able to extrapolate a possible fact family if given the largest number in that fact family (ex. the answer to an addition problem with unknown addends). Through creation of number families, students will gain facility with and improve their recall speed for addition facts and related subtraction facts for sums to 18.

Most importantly, students will enjoy participating in a variety of activities to gain knowledge about fact families and the relationship between addition and subtraction. This unit’s lessons contain varied learning tasks that address a variety of learning styles and integrate other subjects such as writing and visual arts. Although fact families can be a difficult idea for young children to grasp, students will be more likely to master concepts and skills and retain learning if they have fun while exploring and learning about the topic.

**Task 1.4- Unit-Level Learning Targets**

* Students will understand that addition and subtraction are inversely related.

(*Concept LT 1*)

* + **Mathematics 1.2.D** Demonstrate the inverse relationship between addition and subtraction by undoing an addition problem with subtraction and vice versa.
* Students will understand what fact families are and how they can be used to solve addition and subtraction problems. (*Concept LT 2*)
  + **Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18.
* Students will be able to complete fact families if given a number sentence in the family or two addends between 0 and 9. (*Skill LT 1*)
  + **Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18.
* Students will be able to extrapolate a possible fact family if given the largest number in the family. (*Skill LT 2*)
  + **Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18.
* Students will enjoy gaining knowledge about fact families and deepening their understanding of the relationship between addition and subtraction through a variety of activities. (*Disposition LT 1*)

**Task 1.5- Essential Question**

* What are fact families and how can they help me add and subtract?

**Task 2.1- Context of Learning Adaptation**

***Academic Development:*** My internship class consists of 13 female students and 10 male students. Just over half of the students currently perform at grade level in math, and only five students are reading at grade level. Student performance in math ranges widely from students who have little perception of relative number size and still have trouble rote counting to students who have gained facility with basic addition and subtraction and are beginning to independently explore the idea of multiplication through games on the Everyday Math website. One boy in particular struggles with math; he still has trouble counting on and back even with the use of a number line or counters. Despite these academic differences, all students in my internship class are usually enthusiastic learners. They are accustomed to working by themselves for short periods of time, generally fifteen to twenty minutes in length, on independent practice such as worksheets and computer games. They love to learn new information and connect it back to things that they are familiar with from earlier lessons and from their lives in and out of school.

***Academic Language Development***: Several of the students in my internship speak a language other than English at home and have learned English as a second language. Four students receive pullout ELL instruction on a daily basis, and bilingual paraeducators visit the class on a regular basis to assist students. Also, a third of the class has been identified as struggling readers and receives intensive pullout literacy tutoring each day. This means that academic language must be highly scaffolded in order to ensure that all students experience success in usage. On the plus side, the students have a daily reading and writing habit that includes work in content areas. They are engaged in their literacy lessons and love to share what they are currently reading and writing. The students are normally quite talkative and have been learning about the difference between the academic and general social language registers, practicing stating ideas using academic language and sentence structures.

***Social and Emotional Development***: Although they squabble as all young children do, my internship class’ students are a warm-hearted group who love to help each other and try to keep in mind others’ feelings. A talkative group, they love to interact with one another and share their experiences. However, the class does have two girls who have noticeable behavior problems and difficulty interacting in a positive way with their peers. There is also a boy who is very immature for his age socially and emotionally although he was held back last year and is of the oldest students in the class. Also, one girl in the class has selective mutism and rarely speaks aloud to classmates or teachers. Despite these challenges, the other students accept these students for who they are and the class as a whole is a close-knit group. In addition, John Muir’s school-wide STARS Self-Manager program provides a strong framework upon which students build social and emotional skills such as skilled listening and respect. The students all want to be known as “Self-Managers” and work to become self-reliant, resilient problem solvers. This focus on problem solving gives students a framework and vocabulary that they can to apply to problem solving and data gathering in mathematics as well as social situations.

***Family/Community/Cultural Assets***: Families at this school come from a diverse range of family structures and cultural backgrounds, including African-American, Samoan, and Vietnamese. This means that students have a wide variety of lived experiences and rich cultural heritage upon which to draw for background knowledge. This extends to mathematical knowledge as well; students’ families are familiar with different ways of looking at mathematics and different mathematical processes that what students learn at school, providing an added dimension to learning. The majority of students come from low SES households, with most receiving free or reduced-price school lunches. Family involvement in students’ education ranges from relatives who volunteer weekly in the classroom to guardians who are unable to check whether or not their child is completing their homework due to scheduling or personal issues. However, the families of students in this class all understand the value of learning and attempt to accommodate specific teacher requests.

**Task 2.2- Influence of Context of Learning on Instructional Strategies and Learning Tasks**

A key part of effective teaching is making decisions based on the characteristics and needs of students rather than district mandates or curriculum content. I have tailored the instructional strategies and learning tasks of this unit in order to meet the specific needs of my class. Rather than following the Everyday Mathematics curriculum exactly, I have adapted learning tasks from the curriculum and added enrichment activities that integrate visual arts and writing into the unit. This will appeal to my students since they enjoy new activities and any opportunity to exercise their imaginations. Also, since this unit focuses on a single topic in depth, students will work with the same concepts and skills in a variety of activities. This will allow them to try out different ways of thinking about fact families and find a framework that works for them. The extra time spent looking at fact families in depth will also give students time to practice addition and subtraction facts extensively and to think through the meaning of fact families at their own pace. Additionally, every learning activity will be modeled by the teachers using think alouds, a scaffolding technique that will ensure that students have the tools that they need to fully participate in the activity.

In the unit, I have included numerous opportunities for students to work together on learning tasks and to share the work that they have done as well. This will appeal to my students’ social natures and desire for adult and peer attention. Also, cooperative learning and pair work has been proven to be particularly effective in raising academic achievement levels in students from diverse SES households since it promotes high self-efficacy and also taps into cultural values of “communal orientation that emphasizes cooperation and sharing” (Snowman, McCown, & Biehler, 2009, p.163). I have also included two family activities so that students can share what they are learning in class with their family members, building upon their in-class learning with further practice and explanation at home.

**Task 2.3- Family Web Page/Family Activity to Support Student Learning**

The Web page for this unit is located at https://sites.google.com/site/room1factfamilies/. A hard copy sample of the website can be found on pages 40-41 of this document.

In addition to providing updates on what children are studying via a weekly newsletter delivered in their homework folder and daily homework, I will encourage families to ask their students on a regular basis what they are doing in their math lessons. I will also provide two activities for students to complete with a family member or adult friend at home. The first family activity comes directly from the *Everyday Mathematics* curriculum. Students will take home a family letter explaining Fact Triangles and a new sheet of 6 Fact Triangles, as shown in the images below. Students will cut out the Fact Triangles, explain to an adult friend or family member how to use them, and have that person quiz them on addition and subtraction facts. To show that they have participated in the activity with their child, family members will sign the appropriate space in the weekly hard copy newsletter, a familiar routine that takes place every week.

In the second activity, students will work with their family members to create a second fact family picture book or write a fact family story in the spirit of the learning task of Lesson 5 as described below. I will send home pages of the Fact Family Picture Book page template, and family members can help their child write and draw the story that they would like to tell. This will reinforce what students learn in the lesson and give them additional practice in thinking about fact families in a realistic, student-created context.

**Task 3.1- Pre-/Post-Assessment**

I have created the following pre-/post-assessment tool to evaluate students’ achievement of each of the unit-level concept and skill learning targets. With the pre-assessment, delivered prior to the start of the unit, I will gain a general idea of students’ mastery of simple addition and subtraction facts as well as their level of prior exposure to the idea of fact families and the inverse relationship between addition and subtraction. This will allow me to gauge what aspects of the topic I need to focus on more in-depth and divide students into groups for differentiated instruction. Students who show that they already have a conceptual grasp of fact families and the relationship between addition and subtraction can progress at a faster clip. Students who show that they are unfamiliar with fact families and have limited knowledge of addition and subtraction can be given additional preliminary activities to increase their readiness for the unit lessons or allocated additional small-group and individual instructional time during the unit. Based on the results of the pre-assessment, I will be able to adjust my lesson plans according to students’ needs.

By using the same instrument for both the pre-assessment and post-assessment, I will be able to directly compare students’ answers before and after the unit and see how the unit has informed their thinking. This will allow me to document a positive impact on student learning. The concrete examples provided by the post-assessment results will help me determine if there are specific aspects of the topic with which students struggle and should be reviewed further. Also, I will be able to rethink my activity choices and refine my teaching strategies for use with future classes.Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Fact Families Pre-/Post-Assessment**

Circle one (Teacher): Pre-Assessment Post-Assessment

1. Write the fact family for this domino.

\_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_ \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

\_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_ \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

2. Complete the fact family below.

3 + 1 = \_\_\_\_\_ \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

\_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_ \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

3. Fill in the Fact Triangle and write the fact family for it below.

\_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_ \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

11

\_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_ \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

4

4. Complete the fact family below.

\_\_\_\_\_ + \_\_\_\_\_ = 9 \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

\_\_\_\_\_ + \_\_\_\_\_ = 9 \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

5. Tony baked 10 cookies. He gave 4 cookies to his best friend Joe. How many cookies does he have now? Solve the problem and write the fact family for the problem.

\_\_\_\_\_\_ **cookies**  \_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_ \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

\_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_ \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

6. Marisa bought 8 apples from the store. She and her brother were very hungry after school, so they ate 3 for a snack. How many cookies does she have now? Solve and write the fact family for the problem.

\_\_\_\_\_\_ **apples** \_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_ \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

\_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_ \_\_\_\_\_-\_\_\_\_\_ =\_\_\_\_\_

Explain in your own words how you can use a fact family to solve this problem.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. How are addition and subtraction related? Please explain in your own words.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8. What was your favorite fact family activity? Why did you like it? *(Not applicable for Pre-Assessment)*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Tasks 3.2-3.8- Outline of Lessons**

***General Notes:*** The pre-assessment and post-assessment will be administered to students during short class sessions not included in the detailed lesson plans that follow. The class schedule allows for 60 minutes of math daily. Many of the lessons in this unit will depart from the class’ usual math structure of station learning in three small groups with 20 minute focus lessons in favor of exploring different groupings and co-teaching strategies. If my cooperating teacher and I determine that students would benefit from additional exploration and practice with any of the manipulatives used in the unit such as dominoes or Fact Triangles, we will add additional sessions to the unit following the class’ usual math lesson structure where students will participate in small group focus lessons and practice creating fact families with manipulatives during their independent learning time. In terms of technology, my cooperating teacher and I will use the document camera as needed to model activities.

During all lessons, students should display evidence of engagement such as smiling, laughing, and volunteering questions or comments. This will serve as evidence of achievement for the unit’s disposition learning target: “Students will enjoy gaining knowledge about fact families and deepening their understanding of the relationship between addition and subtraction through a variety of activities.”

Homework will also be assigned to students on a daily basis. However, the homework sheets are not included in this unit since they are created in conjunction with the other first grade teachers and often involve extensive review of topics covered in prior units.

**LESSON 1: The Join Machine**

***Duration:*** 60 minutes.

***Learning Target*:**

* Through the use of manipulatives and the Join Machine printout, students will begin to understand that addition and subtraction are inversely related. (*Concept*)
  + ***Evidence of Achievement:*** Students will actively participate in experimenting with the Join Machine and complete a Join Machine worksheet recording different examples of Join Machine Trial Runs.
  + ***Related Unit-Level LT:*** Students will understand that addition and subtraction are inversely related. (*Concept LT 1*)
  + ***Related State Standard:*** **Mathematics 1.2.D** Demonstrate the inverse relationship between addition and subtraction by undoing an addition problem and vice versa.

***Assessment:*** My cooperating teacher and I will circulate through the room and observe students as they experiment with the join machine and fill in their Join Machine worksheets. We will also check the Join Machine worksheets to gauge students’ understanding of the lesson and their accuracy in adding and subtracting numbers using manipulatives.

***Lesson Description:*** This lesson has been designed to get students composing and decomposing small quantities in order to start thinking about subtraction as it relates to addition. First, the teachers will model how to put small cubes through the two input chutes of the Join Machine printable to come out with a single group of cubes, the sum of the two input numbers. Students will try a few example situations posed by the teachers to ensure that they know how the Join Machine works. If any students have particular difficulties with the concept, one teacher will take them aside for intensive reteaching.

Then, students will experiment with different quantities on their own. After a few minutes, the teachers will bring the class together and have students share some quantities they ran through their Join Machines as “trial runs.” Next, teachers will suggest running the Join Machine backwards to decompose a group of cubes into two smaller groups. After experimenting with this, students will complete the Join Machine worksheet, which asks them to document their experiments with the Join Machine and also give and receive instructions from another student about what to put into the machine. This will seem like a game to students but will be deepening their number sense and concept of composition and decomposition of small numbers.

***Resources and Materials:***

* Join Machine printouts
* Join Machine worksheets
* Small cubes
* Colored counters
* Pencils

***Co-Teaching Strategies:*** One Teach, One Assist, Supplemental Teaching, and Team Teaching

Insert Join Machine Copy Here

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Join Machine Worksheet**

1. Using pictures and/or number sentences, show two examples of what you put into the Join Machine and what came out.
2. Try running the Join Machine backwards. What might happen? Draw a picture and write a number model for one test run.
3. Work with a partner and give each other instructions for what to put into the Join Machine. Using pictures and/or a number model, show an example of one test run you completed.

**LESSON 2: Domino Fact Families**

***Duration:*** 60 minutes.

***Learning Targets:***

* Students will become familiar with the concept of fact families by exploring the relationship between the dots on dominoes. (*Concept*)
  + ***Evidence of Achievement:*** Students will participate in an exploration of the dots on dominoes and a discussion about how ­­­­the numbers that go with a domino can be used to make a variety of related number sentences.
  + ***Related Unit-Level LT:*** Students will understand what fact families are and how they can be used to solve addition and subtraction problems. (*Concept LT 2*)
  + ***Related State Standard:* Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18.
* Students will learn how to generate a fact family by using dominoes as manipulatives.
  + ***Evidence of Achievement:*** Students will use dominoes to generate fact families and write the addition and subtraction facts of those fact families on the Domino Fact Family worksheet.
  + ***Related Unit-Level LT:*** Students will be able to complete fact families if given a number sentence in the family or two addends between 0 and 9. (*Skill LT 1*)
  + ***Related State Standard:* Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18.

***Assessment:*** During the lesson, my cooperating teacher and I will informally evaluate students by walking around groups and observing them at work as well as in the group discussion at the end of the lesson. We will also ask students to think aloud to demonstrate their reasoning as we circulate. My cooperating teacher and I will grade the Domino Fact Family worksheets in order to evaluate students’ achievement of the lesson learning targets as well, reteaching to selected students as needed.

***Lesson Description:*** This activity will introduce students to finding fact families using the dots on dominoes. Students will be divided into two smaller groups. First, hand out a domino to each student and then have students examine their dominoes. As a group, discuss students’ observations and the numbers that can be found on dominoes.

Next, students will draw their domino on their whiteboard and think of as many number sentences that they can think of involving just the three numbers that go with the domino. As a group, students will share the facts that they have written and look for patterns. For example, a student might notice the fact that if the two numbers on the domino are different, there are two different addition number models for that domino. Hopefully, at least one student will think to write subtraction number models with their domino dot numbers. If not, the teacher can elicit students to come to the realization that the numbers can also be used to write subtraction facts. Then, the teachers will introduce the term “fact families” and talk about the concept with students.

In the final part of the lesson, students will receive two more dominoes and write the fact families for the numbers depicted with the dots on their Domino Fact Family Worksheets. They can use counters if they need to maneuver individual objects to help them come up with the correct number sentences.

***Resources and Materials:***

* Domino Fact Family worksheets
* Whiteboards and whiteboard markers
* Dominoes
* Colored counters
* Pencils
* Document camera

***Relevant Co-Teaching Strategies:*** Parallel Teaching, Supplemental Teaching

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Domino Fact Family Worksheet**

Draw the number of dots on your domino. Write down or draw pictures for as many number sentences as you can find that use only the numbers on your domino. We will be sharing and discussing our findings with the group.

**LESSON 3: Exploring Number Triangles**

***Duration:*** 60 minutes. The first 20 minutes of class will be a warm-up exercise where students will hold a paper that displays a number or mathematical symbol and physically move to create fact families. Then the class will break into two groups for a focus lesson about number triangles conducted using parallel teaching. Finally, students will separate into pairs to practice using the number triangles and complete a worksheet.

***Learning Targets:***

* Students will understand what Fact Triangles are and how they show the relationship between addition and subtraction. (*Concept*)
  + ***Evidence of Achievement***: Students will participate in a group discussion where they discuss the properties and uses of Fact Triangles as well as using Fact Triangles to solve addition and subtraction problems.
  + ***Related Unit-Level LT:*** Students will understand that addition and subtraction are inversely related. (*Concept LT 1*)
  + ***Related State Standard:*** **Mathematics 1.2.D** Demonstrate the inverse relationship between addition and subtraction by undoing an addition problem with subtraction and vice versa.
* Students will be able to use Fact Triangles to practice addition and subtraction facts. (*Skill*)
  + ***Evidence of Achievement:*** Students will form pairs and quiz their partners on addition and subtraction facts using Fact Triangles in the way discussed in the focus lesson.
  + ***Related Unit-Level LT:*** Students will be able to complete fact families if given a number sentence in the family or two addends between 0 and 9. (*Skill LT 1)*
  + ***Related State Standard:*** **Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18.
* Students will be able to use Fact Triangles to create fact families. (*Skill*)
* ***Evidence of Achievement:*** Students will work in pairs to select at least two Fact Triangles and write complete addition and subtraction fact families for those Fact Triangles on lined paper.
* ***Related Unit-Level LT:*** Students will be able to complete fact families if given a number sentence in the family or two addends between 0 and 9. (*Skill LT 1*)
* ***Related State Standard:* Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18.
* Students will use interpersonal and communication skills to work together to perform tasks and solve problems. (*Skill*)
* ***Evidence of Achievement:*** Students will quiz each other on addition and subtraction facts using Fact Triangles and work together to write at least two fact families based on Fact Triangles.
* ***Related State Standard:* Communication Component 2.2** Uses interpersonal skills and strategies in a multicultural context to work collaboratively, solve problems, and perform tasks.

***Assessment:*** Students will complete a self-assessment entitled Fact Triangle Self-Evaluation wherein they will evaluate their ability to use Fact Triangles in various ways and how well they worked with their partners. My cooperating teacher and I will also informally observe students as they work and evaluate their fact family number sentences for accuracy.

***Lesson Description:*** For the warm-up activity, teachers will hand out numeral and symbol cards to students. Certain strategically selected students, such as the girl with selective mutism, will be assigned to pairs since there will not be enough papers for every student to have one individually. Teachers will ask students to volunteer numbers to make a fact family. When students have contributed the 3 numbers that make up a family, the teacher (in later rounds, a student) will say the first number sentence that makes up the fact. Students holding the correct numbers and symbols will come to the front of the room and arrange themselves in the correct order to make the fact family. They will then read their numbers and symbols out loud, creating a numbers sentence. Have one of the observing students repeat the sentence in its entirety. Repeat until all students have a chance to come up front as part of a fact family or until the allotted time is up.

Next, students will break into two groups selected based on ability and participate in a focus lesson on number triangles. To save time, the first page of Fact Triangle cards will already be cut out by a parent volunteer. Students will first investigate the Fact Triangles in pairs, talking about what they notice. In their whole group, they will discuss what they have observed about the Fact Triangles. Then, the teacher will elaborate on student contributions to talk about the different parts of Fact Triangles and explain how they can be used to practice addition and subtraction facts and fact families. Students can cover one number on the Fact Triangle and have their partners give an addition or subtraction fact that has the covered number as the answer. They can also cover the answer and ask their partners to solve the addition or subtraction problem.

Finally, students will work in pairs to quiz each other on addition, subtraction, and fact families. Pairs will also work together to choose at least two Fact Triangles with which to practice number families. They will say and then write the number sentences that make up those Fact Triangles’ number families on lined paper, which they will turn in at the end of the lesson.

***Resources and Materials:***

* + Colored paper with the numerals 0-16 and symbols +, -, and = written on them
  + Fact Triangle set (ActivitySheets 9 and 10 from Math Journal 2, see attached example)
  + Fact Triangle Self-Assessments
  + Lined paper (for fact family recording)
  + Pencils
  + Document camera

***Relevant Co-Teaching Strategies:*** Team Teaching, Parallel Teaching, and Supplemental Teaching

Insert Fact Triangle Sample Sheet

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Fun with Fact Triangles Self-Evaluation**

|  |  |  |  |
| --- | --- | --- | --- |
|  | ☺ | 😐 | ☹ |
| I know how to use Fact Triangles to solve/quiz myself and others on addition problems. |  |  |  |
| I know how to use Fact Triangles to solve/quiz myself and others on subtraction problems. |  |  |  |
| I know how to use Fact Triangles to make fact families. |  |  |  |
| My partner and I listened to each other and worked well together. |  |  |  |

Write one thing that you and your partner did well together and one thing you would like to work on next time.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**LESSON 4: “Building” Fact Family Houses**

***Duration:*** 60 minutes. The first 15 minutes of class will be a fact family warm-up. The rest of class will be devoted to creating the fact family houses.

***Learning Targets:***

* Students will follow a step-by-step process to create a Fact Family House with decorated exterior and fact family written on the interior. (*Skill*)
  + ***Evidence of Achievement:*** Students will write the fact family’s numbers and addition and subtraction facts on the interior of the house, decorate the outside of the house using the medium of their choice, and cut and staple the two pieces to create a complete Fact Family House.
  + ***Related State Standard:* Visual Arts 2.1.**1 Applies a creative process to the visual arts.
* Students will choose a number from differentiated choices provided to them and extrapolate a fact family where that number is the sum of the other two numbers in the fact family. (*Skill*)
* ***Evidence of Achivement:*** Students will write a number family for the number of their choice on the interior of their Fact Family House, using counters to help determine the correct number sentences if necessary.
* ***Related Unit-Level LT:*** Students will be able to extrapolate a possible fact family if given the largest number in the family. (*Skill LT 2*)
* ***Related State Standard:*** **Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18.

***Assessment:*** During the lesson, my cooperating teacher and I will observe students and conduct several “thumbs-up, thumbs-down” checks for understanding as informal formative assessments. In addition, I will use the following checklist to assess students’ performance on the learning task of creating a fact family house:

|  |
| --- |
| ***Fact Family House Checklist*** |
| * Fact family numbers and number sentences are written in the correct areas of the Fact Family House interior. * All numbers in the fact family are listed. * The number sentences that make up the fact family are correct. * The exterior of the Fact Family House is decorated with care and ready to be displayed on a bulletin board. |

***Lesson Description:*** If not all students had a chance to go up front during the warm-up activity in Lesson 3, we will continue the activity at the beginning of the lesson. Otherwise, the lesson will begin with a brief discussion of what students have learned about fact families in activities so far. Teachers will try to elicit the idea of using fact families to solve word problems to foreshadow the main learning task of Lesson 5.

Then, students will create Fact Family Houses. A version of this activity is outlined on page 558 of *Everyday Mathematics: Grade 1*. First, my cooperating teacher and I will model the activity. Next, based on students’ ability levels, my cooperating teacher and I will give students several numbers of varying size (ex. 3, 4, 5, and 6 for students who struggle with math) to choose amongst. Students will then extrapolate a fact family using this number as the largest number in the fact family, the sum of the addends. Students will write the addition and subtraction number sentences that make up this fact family on the interior of their Fact Family House, decorate their Fact Family House cover, and then cut the two out and staple them together. If time allows, students will form small groups to share their Fact Family Houses with one another.

***Resources and Materials:***

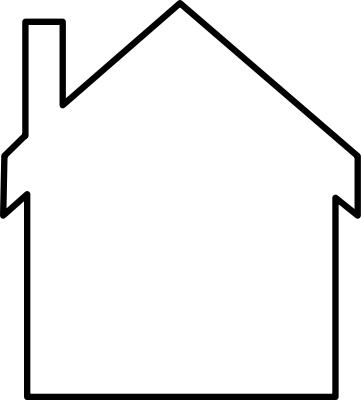
* Fact Family House Checklists (for teacher use)
* Fact Family House Cover printables
* Fact Family House Interior printables
* Pencils
* Colored pencils, crayons, and markers (for coloring/decorating cover)
* Dominoes, Fact Triangles, and small cubes (to use as aids for finding fact family number sentences)
* Document camera

***Relevant Co-Teaching Strategies:*** One Teach, One Assist and Team Teaching

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Fact Family House Interior**

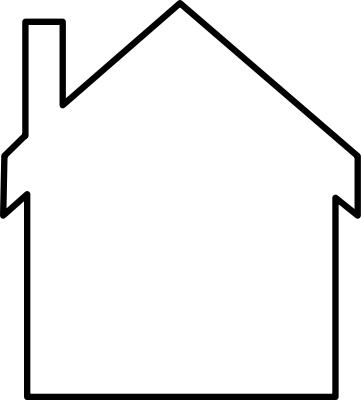
Write the numbers of your fact family in the top section of your fact family house (where the roof is). Write the number sentences that make up your fact family in the bottom section of your house.



Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Fact Family House Cover**

Decorate the cover of your fact family house.



**LESSON 5: Creating Fact Family Picture Books**

***Duration:*** 60 minutes. The first 30 minutes of the lesson will be devoted to a mini-lesson that elaborates on using fact families to solve subtraction word problems and participating in a shared writing exercise where students will work together with the teachers to create an example fact family picture book. During the remaining 30 minutes of class, students will create their own fact family picture book.

***Learning Targets:***

* Students will deepen their understanding of how the number sentences in fact families relate to each other and how fact families can be used to solve addition and subtraction word problems with a realistic context. *(Concept)*
  + ***Evidence of Achievement:*** Students will participate in a shared writing exercise and then create individual fact family picture books that show how the number sentences in a fact family relate to one another.
  + ***Related Unit-Level LT:*** Students will understand what fact families are and how they can be used to solve addition and subtraction problems. *(Concept LT 2)*
  + ***Related State Standard:*** **Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18.
* Students will create a story that uses the addition and subtraction facts of a fact family in a realistic context. (*Skill*)
  + ***Evidence of Achievement:*** Students will include accurate illustrations and numbers sentences depicting an addition and subtraction fact family of their choosing.
  + ***Related Unit-Level LT***: Students will be able to extrapolate a possible fact family if given the largest number in the family. (*Skill/Process LT 2)*
  + ***Related State Standards:* Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18. **Mathematics 1.2.H** Solve and create word problems that match addition or subtraction equations.

***Assessment:*** Students will be informally observed over the course of the lesson. Students that still appear to be struggling with fact families or the idea of how to incorporate fact family addition and subtraction facts into stories will be taken aside and given additional instruction as the rest of the class begins to work on their picture books. The completed picture books will be assessed using the Fact Family Picture Book Rubric after Lesson 6.

***Lesson Description:*** First, teachers will give some examples of subtraction word problems and elicit student responses for how they can be solved using fact families. By this time, students will be experienced with the content of and creating fact families, so they should be able to see that they should be able to solve a subtraction problem if they know the related addition fact that is part of the same fact family.

Then, the class will gather in their usual reading lesson spot at the back of the classroom. The teachers will explain that each person in the class will write a fact family picture book where all of the numbers in the fact family are represented by the same object. For example, if the first page of the book is about how Bob had 5 ducks and lost 2, the next page of the book should also deal with Bob’s ducks instead of unrelated objects. To model this, the class will write a fact family picture book together as a shared writing exercise.

Finally, students will individually create their own fact family picture book. It must include pictures that represent the fact family number sentences as well as a written component. If students are not comfortable writing their entire story out in words, they may write the addition and subtraction facts and verbally elaborate on their story during their presentation in the following lesson.

***Resources and Materials:***

* Enlarged Fact Family Picture Book page templates (for use in the shared writing exercise)
* Fact Family Picture Book page templates
* Plain white paper (for use as an optional book cover)
* Pencils
* Colored pencils, crayons, and markers (for coloring pictures)
* Dominoes, Fact Triangles, and small cubes (to use as aids for finding fact family number sentences)

***Relevant Co-Teaching Strategies:*** Team Teaching and Supplemental Teaching

**LESSON 6: Fact Family Picture Book Celebration**

***Duration:*** 60 minutes. The first 15 minutes will be devoted to finishing fact family picture books. During the last 45 minutes, students will share their books with their classmates.

***Learning Targets:***

* Students will deepen their understanding of how the number sentences in fact families relate to each other and how fact families can be used to solve addition and subtraction word problems with a realistic context. *(Concept)*
  + ***Evidence of Achievement:*** Students will listen attentively as their classmates present their fact family picture books and correctly answer questions posed by the teacher.
  + ***Related Unit-Level LT:*** Students will understand what fact families are and how they can be used to solve addition and subtraction problems. *(Concept LT 2)*
    - ***Related State Standard:*** **Mathematics 1.2.F** Apply and explain strategies to compute addition facts and related subtraction facts for sums to 18.
* Students will use communication skills and strategies to effectively present their ideas such as those in their fact family picture book. *(Skill)*
  + - ***Evidence of Achievement:*** Students will share their fact family picture book with the class, facing their classmates and speaking in a clear voice.
  + ***Related State Standard:*** **Communication 3.3.1** Applies skills for delivery of effective oral communication and presentations.

***Assessment:*** As students share their fact family picture books, my cooperating teacher and I will observe students. One of us will write anecdotal notes regarding their behavior as part of an audience, looking for displays of active listening as conveyed by body language and attentive silence. The other teacher will observe students as they present their book and take anecdotal notes regarding their presentation and their ability to articulate fact families correctly while telling their story, which will come into play when evaluating the picture books using the rubric. The completed fact family picture books will be assessed formally using Fact Family Picture Book Rubric below.

***Lesson Description:*** The lesson will begin with students finishing the fact family picture books that they began in Lesson 5. Students who finish with their picture books will be given the option of completing pages from their Math Journal that relate to fact families, quizzing each other on addition and subtraction facts and/or fact families using number triangles, or playing number sentence memory with dominoes.

In the second portion of the lesson, students will share their fact family picture books with the class. The class will gather in their usual reading lesson spot and my cooperating teacher and I will model how to share with the book that we wrote during the shared writing exercise in Lesson 5. Then, each student will come to the front to present their book, speaking in a clear voice. This will allow students who aren’t as comfortable writing to articulate the concept behind their book and verbally clarify the word problems/number sentences in the book. The teachers will periodically ask fact family questions that relate to the books being shared. If students get fidgety, we will have them get up and do a brief exercise where they physically show different fact families using their fingers.

For the next week, the fact family picture books will remain on display. Students will be able to check them out and read them alone or with a partner when they finish their independent practice during station teaching math lessons.

***Resources and Materials:***

* Fact Family Picture Book page templates
* Plain white paper (for use as an optional book cover)
* Pencils
* Colored pencils, crayons, and markers (for coloring pictures)
* Dominoes, Fact Triangles, and small cubes (to use as aids for finding fact family number sentences and after finishing picture book)
* Math Journals (for use if students finish picture book early)
* Fact Family Picture Book rubrics (for teacher use)
* Picture Book Anecdotal Notes worksheets (for teacher use)

***Relevant Co-Teaching Strategies:*** Team Teaching

Picture Book Anecdotal Notes

|  |  |  |  |
| --- | --- | --- | --- |
| **Ahtziri** | **Alexander** | **Arionna** | **Earl** |
| **Emmanuel** | **Feben** | **Francis** | **Hank** |
| **Hibaq** | **Jamari** | **Jamel** | **Jed** |
| **Jezey** | **Kelly** | **Marcus** | **Maria** |
| **Marianna** | **Owen** | **Quinn** | **Ramona** |
| **Sona** | **Tina** | **Unique** |  |

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**Fact Family Picture Book Rubric**

**(For Teacher Use)**

Student Name: ­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| 3  Meets Expectations | All of the following criteria were met:   * Picture book contained all facts for a single fact family. * All addition facts for the fact family were correct. * All subtraction facts for the fact family were correct. * Picture book contained writing or number models to represent the different parts of the fact family. * Picture book contained illustrations that represented the different parts of the fact family. * Presentation of the fact family picture book was easy to understand, made sense, and delivered in a clear voice.   AND   * Picture book showed evidence of careful thought and effort. |
| 2  Almost There | One or two of the following were missing:   * Picture book contained all facts for a single fact family. * All addition facts for the fact family were correct. * All subtraction facts for the fact family were correct. * Picture book contained writing or number models to represent the different parts of the fact family. * Picture book contained illustrations that represented the different parts of the fact family. * Presentation of the fact family picture book was easy to understand, made sense, and delivered in a clear voice. |
| 1  Not Quite | More than two of the following were missing:   * Picture book contained all facts for a single fact family. * All addition facts for the fact family were correct. * All subtraction facts for the fact family were correct. * Picture book contained writing or number models to represent the different parts of the fact family. * Picture book contained illustrations that represented the different parts of the fact family. * Presentation of the fact family picture book was easy to understand, made sense, and delivered in a clear voice.   OR   * Fact family picture book was missing. |

**Task 4.1- Connections to Theory and Research**

I have planned this unit around several essential learning principles such as deep learning and engagement in order to ensure that all of my students have the opportunity to learn. One key learning principle that I tried to implement in this unit is that of deep learning. According to Newmann, King, & Carmichael (2007), “knowledge is deep when, instead of trying to learn or expressing only fragmented pieces of information, students encounter different applications of central concepts aimed toward integrated or holistic understanding” (p. 37). This unit is structured around an essential question: “What are number families and how can they help me add and subtract?” The unit-level learning targets and lessons all relate back to this essential question, which provides a strong focus and momentum for the unit.

This also ties into the highly focused topic and structure of my unit. As I stated in my rationale, I chose to select a single topic, fact families, and take it from introduction to mastery in a series of lessons because I felt that this would increase the chance that students would become confident using it as a tool and a springboard for deeper thought regarding the relationship between addition and subtraction. As Burns (2007) states, “the more you work with a new idea, the more opportunity you have to internalize parts of it, which frees you to consider other aspects” (p. 66). Although Burns was addressing teachers, she goes on to acknowledge that the same holds true for students as well. By designing a unit where students work extensively with addition and subtraction within the idea of fact families, I hope to give them the chance to internalize the idea as a potential problem-solving tool and deepen their understanding of how subtraction and addition are related.

Additionally, I have tried to structure the unit so that the learning tasks move students from building a general conceptual understanding of addition and subtraction, as seen in the Join Machine lesson, to more focus on the procedure for generating addition and subtraction facts in fact families as seen in activities like working with Fact Triangles or the Fact Family House. According to Bornemann, Bright, Drury, & Lewis, a “major focus for grades K-2 is to develop a deep sense of number, number relations, and foundations for operations” (p.1).Beginning with the Join Machine allows students to develop their sense of number relations using concrete materials before moving into abstract application of the idea in making fact families. In keeping with Roberts’ assertion that “a dynamic relationship exists between conceptual and procedural knowledge” (2010, p. 197), the fact family picture book learning task combines the procedural and conceptual. Students create a fact family, which requires knowledge of how to find the fact family’s addition and subtraction facts, but then they put the fact family into the context of a story about a certain number of objects, which requires conceptual understanding of word problems as well as the relationship between the numbers in the fact family. This is a more sophisticated return to the association between the numbers in the addition and subtraction facts and objects.

During the course of the unit, I have also tried to engage students in higher order thinking. Newmann et al. state that higher order thinking “requires students to manipulate information and ideas in ways that transform their meaning and implications” (p. 35). Students are engaged in higher order thinking when they combine facts and ideas to reach a new, larger conclusion. This unit promotes higher order thinking by providing numerous occasions for students to discuss observations or problem solutions and also articulate their thinking about how and why things are the way they are. The self-assessment that students will complete during the unit is another example of asking students to engage in higher-order thinking, this time by reflecting on their learning. Considering and then judging their performance using a self-assessment form moves the class away from a model where the teacher serves as sole judge in the classroom towards a model where students take more responsibility for their learning (Munns, Woodward, & Koletti, p.18). It also encourages students to think objectively about their behaviors, strengths, and weaknesses, promoting their growth as team members and learners. Students have to engage in the higher order thinking levels of analysis and evaluation, building powerful skills and meaning.

Engagement is another key principle of learning that I have focused on in the planning of the unit. According to Erikson’s theory of psychosocial development (Snowman et al., 2009), children in elementary school will develop a sense of industry and positive self-efficacy if they are “encouraged to make and do things well, helped to persevere, allowed to finish tasks, and praised for trying” (p. 27). For this reason, I have purposefully designed meaningful learning tasks and projects that can be completed during the unit’s brief timeframe. Through completion of numerous small but powerful activities, students will build their confidence in their skills and knowledge surrounding the topic of fact families and addition and subtraction. The use of group sharing allows students to receive feedback and validation not just from teachers, but from their peers as well, building self-confidence and positive self-efficacy.

Also, the use of manipulatives such as dominoes and counters in the unit’s learning tasks increases students’ engagement and learning. According to Roberts (2010), students are “clearly more engaged using manipulatives as compared with working through…exercises with paper and pencil” (196). In first grade, most students are still in either what Piaget terms the preoperational stage or the beginning of the concrete operational stage (Snowman et al., 2009). This means that students are capable of forming generalizations, but only if they are drawing from concrete experiences. For this reason, using physical objects as manipulatives is key in building lasting understanding as well as task engagement.

**Task 4.2- Academic Language**

There are many oral and some written language demands inherent in the unit’s learning tasks. First, the unit has several new or unpracticed terms that students will encounter repeatedly during the unit. These key terms are: *addition, subtraction, addends, sum, number sentence, number model, fact family,* and *Fact Triangle*. Also, students will need to be familiar with the language of problem-solving, which includes the ability to identify both the question in a problem and the information needed to solve it. Finally, students will need to translate numerical expressions that they see written as number sentences or depicted using manipulatives into verbal language. They will need to understand what different symbols and numerals mean and how to say them in English in the commonly accepted manner.

Although conceptual knowledge trumps linguistic perfection in early elementary mathematics, a foundational knowledge of the vocabulary and other language demands as stated above is necessary for students to get the most out of the learning tasks and have a base of linguistic knowledge to build upon as further or related concepts are introduced. In order to help students meet the language demands for the unit, I will explicitly teach new vocabulary words and encourage students to phrase verbal answers using standard mathematical expressions. Since the unit focuses closely on one topic, the learning tasks will involve natural repetition of key terms so students will have numerous chances to practice the language and internalize its meaning. Since the unfamiliar terms are used in a variety of learning tasks designed to be fun and engaging, students will have an emotional association with the language to increase its meaningfulness (Eva & Walker, 2009). This raises the chances that the language will be transferred into students’ long-term memories. Also, since I am teaching and modeling the use of the language first and then giving students the opportunity to interact with each other using the same language, I am allowing them to gradually become familiar with the language and confident meeting the language demands.

**Task 4.3- Special Needs**

As stated above, my internship class has a number of students with special learning needs even though there are no students currently on IEPs or 504s. Eight students receive pullout intensive literacy tutoring and four students receive pullout ELL instruction. In addition, there are two girls who have severe behavioral issues, one boy who is socially and emotionally immature for his age, and one girl who has selective mutism. During the unit, I will check in more frequently with these students to make sure that they are making adequate progress towards the unit’s learning targets and work with them to set individualized goals as appropriate.

In this unit, students become familiar with concepts as well as skills. This will allow them to build a foundation of understanding that they can return to in the future as the *Everyday Mathematics* curriculum revisits fact families and the addition-subtraction relationship. The unit’s lessons focus on creation of shared experiences before proceeding to individual activities, allowing students to build a common base of conceptual knowledge and learn from their peers. Even if students are not yet comfortable working with larger numbers or certain addition facts, they will be able to learn the concepts through exploration and apply them to problems using smaller numbers with which they can more easily work. Also, since this unit provides many different activities, all students can experience success and engagement regardless of struggles with certain aspects of literacy or numeracy. The varied learning tasks provide numerous opportunities for students to take control of their own learning, like choosing items they are passionate about for their fact family picture book or choosing numbers with which they wish to work. The framework of each lesson includes opportunities for students to unobtrusively work at their own levels and practice skills at their own pace, necessary differentiation for students with special learning needs.

Also, the frequent use of parallel teaching and supplemental teaching during the unit will ensure that students with special learning needs receive ample individualized and small group instruction. My cooperating teacher and I will monitor students’ work and progress, altering our instructional plans as necessary so that all students are receiving the amount and level of instruction they need to succeed and build their sense of positive self-efficacy. I will also provide adaptations for assignments and assessments to individual students as necessary in order for them to feel safe and confident demonstrating their achievement of learning targets. For example, on the post-assessment, I will allow students with special literacy needs to verbally complete or clarify the questions on the post-assessment that ask them to state their thinking in own words. This will allow them to answer the question fully without the stress that writing brings curtailing expression of their thoughts.

**Task 5.4- Annotated Bibliography**

Bell, J., Bell, M., Bretzlauf, J., Dillard, A., Hartfield, R., Issacs, A.,…Saecker, P. (2007). *Everyday Mathematics: Grade 1*. Chicago, IL: Wright Group/McGraw Hill.

* *Everyday Mathematics* is an integrated spiral curriculum that consists of units of problem-solving lessons constructed around a common theme. I pulled the topic for this unit and adapted some lesson content from Unit 6: Building fact power, which is a “kitchen sink” unit that covers basic addition facts, fact families, equivalent names, measuring in centimeters, digital notation for time, and quarters as a monetary unit.

Bornemann, G., Bright, G., Drury, B., & Lewis, K. (2008) Algorithms. *Washington Mathematics 52*(5), 1-4.

* This article talks about algorithms and their purpose and importance in K-12 mathematics. The latter part of the article provides an introduction to the role of algorithms in different grades.

Burns, M. (2007) *About Teaching Mathematics: A K-8 Resource (3rd ed.).* Sausalito, CA: Math Solutions Publications.

* This textbook introduces a practical approach to teaching mathematics focusing on problem solving activities with real life connections.

Eva, A. & Walker, B. (2009). General strategies for enhancing long-term memory [MIT TEED 512 handout].

* This handout details strategies for enhancing long-term memory using effort, meaningfulness, organization, familiarity, active rehearsal, and emotion.

Munns, G., Woodward, H., & Koletti, J. (2006). Engagement and student self-assessment. In NSW Department of Education and Training (Ed.), *School is for me: Pathways to student engagement* (pp.15-24). Sydney, NSW: NSW Department of Education and Training.

* Created by a number of Australian educators, this book features strategies for promoting engagement with learning in students from low SES households. This particular chapter details how reflective student self-assessment encourages students to take responsibility for their learning and increases engagement.

Newmann, F.M., King, M.B., & Carmichael, D.L. (2007). Authentic instruction and assessment: Common standards for rigor and relevance in teaching academic subjects. Des Moines, IA: State of Iowa Department of Education.

* This document elaborates on cross-subject methods of instruction and assessment that promote enhanced student learning, with emphasis on principles of effective instruction such as substantive communication and deep knowledge.

Petti, W. (2011). Addition and subtraction idea bank. Retrieved from: http://www.mathcats.com/grownupcats/ideabankaddition.html

* This website has a very 1990s design and many suggestions for addition and subtraction activities that vary widely in quality. I adapted the fact family warm up in Lesson 3 from one posted on this page.

Roberts, S.K. (2010). The conceptual chicken and the procedural egg. *Mathematics Teaching in the Middle School, 16*(4), 196-198.

* This article explores the effective use of manipulatives in math instruction and the ebb and flow of conceptual and procedural learning.

Snowman, J., McCown, R., & Biehler, R. (2009). *Psychology applied to teaching* (12th ed.). Boston, MA: Houghton Mifflin Company.

* This book provides a thorough overview of developmental psychology and educational strategies.

Washington State Office of the Superintendent of Public Instruction. (2011). Online grade level standards & resources. Retrieved from http://standards.ospi.k12.wa.us/

* This website features an online search engine for Washington State’s K-12 EALRs and GLEs for all subjects.